IS 3675 (1966): Method for Determination of Bundle Strength (Tenacity) of Cotton Fibres [TXD 1: Physical Methods of Tests]

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Indian Standard

METHOD FOR DETERMINATION OF BUNDLE STRENGTH (TENACITY) OF COTTON FIBRES

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BUREAU OF INDIAN STANDARDS
MANAK BHAVAN, 9 BAHADUR SHAH ZAFAR MARG
NEW DELHI 110002

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TO
IS 3675 : 1966 METHOD FOR DETERMINATION OF BUNDLE STRENGTH (TENACITY) OF COTTON FIBRES

(*Page* 4, *clause* 1.3) — Insert the following as a new clause after 1.3:

'1.4 In view of theoretical deficiencies of Pressley-type of tester, it shall not be used in case of disputes.'

(*Page* 7, *NOTE under clause* 8.2.2, *line* 1) — Incorporate the words 'and 3.175 mm(1/8")' between the words 'zero' and 'guage'.

(*Page* 7, *NOTE under clause* 8.2.2, *line* 2) — Substitute 'lengths' *for* 'length'.

(TX 01)

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Indian Standard

METHOD FOR DETERMINATION OF BUNDLE STRENGTH (TENACITY) OF COTTON FIBRES

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Indian Standard

METHOD FOR DETERMINATION OF BUNDLE STRENGTH (TENACITY) OF COTTON FIBRES

0. FOREWORD

0.1 This Indian Standard was adopted by the Indian Standards Institution on 20 July 1966, after the draft finalized by the Textile Standards Sectional Committee had been approved by the Textile Division Council.

0.2 Strength of cotton fibre contributes substantially to the quality of cotton. The method of estimating the tenacity of cotton by testing individual fibres is tedious and time consuming. For both commercial and technical purposes, quicker methods have been developed which test the fibres in the form of bundles. This standard covers some such methods.

0.3 The bundles of fibres may be secured by clamps which are either in close contact (zero gauge length) or by clamps separated to give a finite gauge length. Fibre strength testing at zero gauge length is a current commercial practice, although investigations indicate that tests at a finite gauge length of 3·175 mm (or 1/8 in) may be more closely related to the tenacity of many classes of cotton yarn.

0.4 International Calibration Cotton Standards have been established to enable different operators to adjust their personal level of testing to an agreed common level.

0.5 While formulating this standard, the Committee concerned did not feel called upon to lay down a sampling procedure for drawing a bulk sample from material collected from the field, the gin, the mill, the warehouse or the market. The bulk sample, it is expected, will be drawn so as to be representative of the lot under investigation.

0.6 While formulating this standard considerable assistance has been derived from:

Doc: ISO/TC 38/SC 6/WG 1 (Secretariat 71) 81 Draft proposal standard method for determination of tenacity of flat bundles of cotton fibres. International Organization for Standardization.

ASTM Designation: D 1445-64T Method of test for strength and elongation of cotton fibres (flat bundle method). American Society for Testing and Materials.

0.7 In this standard generally metric values have been specified. However, where found necessary, to familiarize the industry with the metric values equivalent fps values have also been given. Since Pressley instrument, which is calibrated in fps units, is indispensable to the textile industry at present, the pound value is used in the calculations appearing in **11** but the final result is expressed in metric units.

0.8 In reporting the result of a test made in accordance with this standard, if the final value, observed or calculated, is to be rounded off, it shall be done in accordance with IS : 2-1960*.

1. SCOPE

1.1 This standard prescribes a method for determination of strength of flat bundles of cotton fibres arranged in parallel manner. The method is applicable to fibres being tested either at zero gauge length or at 3·175 mm (or 1/8 in) gauge length.

1.2 The standard is applicable to fibres from raw cotton or to fibres from various stages in the manufacturing process or to fibres separated or extracted from manufactured cotton products.

1.3 This standard is especially intended to be used with strength testing instruments which have been designed for specific use of testing flat bundles of cotton fibres (*see* Appendices A and B).

2. PRINCIPLE

2.1 A flat bundle is fastened in a pair of clamps of prescribed size and the fibres protruding beyond the clamps are cut. Increasing force is applied to the specimen until it ruptures. The broken fibres are weighed and the ratio of the breaking load to the weight of fibres is determined and the tenacity is calculated therefrom. The test may be carried out either at zero or at 3·175 mm (or 1/8 in) gauge length.

3. TERMINOLOGY

3.0 For the purpose of this standard, the following definitions shall apply.

3.1 Flat Bundle — A test specimen consisting of a thin layer of parallel fibres arranged with the centres of the fibres substantially colinear across the width which is approximately 6 mm (¼ in).

3.2 Tenacity — The maximum load applied during a tensile test on a bundle of fibres carried to rupture divided by the mass per unit length of the bundle.

NOTE — Tenacity is usually expressed in terms of force per unit cross-sectional area. However, the tenacity of textile strands is mostly expressed in terms of force per unit linear density, for example, in grams weight per tex.

*Rules for rounding off numerical values (*revised*).

3.3 Gauge Length — The distance between the inner faces of the pair of clamps at the start of the test.

4. SAMPLING

4.1 Gross Sample — Take samples at random from the different portions of the bulk sample to make up a **gross sample** weighing from 250 to 1 000 g.

NOTE — If the bulk sample weighs less than 250 g, the whole of it shall constitute the **gross sample**.

4.2 Test Sample — Spread the gross sample evenly on a level surface in the form of a square with each side slightly more than one metre. Over this, place a metallic framework 1 × 1 m (inside dimensions) divided into 25 equal sub-squares. From each of these sub-squares, pull out at random approximately equal bunches of fibres so as to get a sample weighing about 100 g. This shall constitute the **test sample**.

4.3 Laboratory Test Sample — Spread the test sample and divide it into 25 approximately equal groups. Extract small pinches of loose fibres at random from each group, thus obtaining a composite **laboratory test sample** weighing from 300 to 500 mg. Blend the loose cotton fibres from each pinch by preparing either a hand sliver or by using a mechanical blender. Condition the laboratory test sample thus obtained to a state of moisture equilibrium (*see* **5.1**).

NOTE — If mechanical blenders are used, care shall be taken to avoid fibre damage.

5. CONDITIONING OF LABORATORY TEST SAMPLE

5.1 The laboratory test sample shall be conditioned in standard atmosphere at 65 ± 2 percent relative humidity and 27° ± 2°C temperature for 4 hours (*see also* IS : 196-1966*).

5.2 Pre-conditioning may be used if the contract specification requires it or if the laboratory test sample is very moist. If so, the laboratory test sample shall be brought approximately to equilibrium in an atmosphere having relative humidity between 10 percent and 25 percent and a temperature not exceeding 50°C.

5.2.1 These conditions may be obtained by heating air at 65 percent relative humidity and 27°C temperature to a temperature up to 50°C.

6. ATMOSPHERIC CONDITIONS FOR TESTING

6.1 The test shall be carried out in standard atmospheric conditions (**5.1**).

*Atmospheric conditions for testing (*revised*).

7. APPARATUS

7.1 Balance — capable of weighing to an accuracy of ±0·01 mg.

NOTE — A balance of capacity 0 to 5 mg is sufficient for most fibre bundle strength tests. If test specimens are to be weighed collectively (*see* Note 1 under **11.1.2**), use a balance of capacity 0 to 10 mg or 0 to 20 mg capable of weighing to an accuracy of ± 0·02 mg.

7.2 Fibre Bundle Strength Tester — Two commercially available fibre bundle strength testers are described in Appendices A and B. Other strength testers may be used, if equipped with adapters to accommodate the fibre clamps of Pressley type. The strength tester shall be equipped with the following accessories.

7.2.1 *Specimen Clamps (of Pressley Type)* — A pair of clamps with a combined width of 11·81 mm (0·465 in), while testing at finite gauge length, a suitable spacer, usually of 3·175 mm (or 1/8 in) may be used between the clamps.

7.2.2 *Clamp Vice* — A jig equipped with a locking screw or cam for holding the clamps while they are being loaded and unloaded. A vice equipped with an appropriate construction to ensure the application of predetermined force when tightening the jaws of the clamps, may be preferred.

7.2.3 *Devices* — For preparation of specimens and removing them from the clamps:

a) *Coarse comb* — with approximately 8 teeth per 25 mm (1 in).

b) *Fine comb* — with approximately 52 teeth per 25 mm (1 in).

c) *Wrench* — for tightening the clamps. A torque wrench is needed, if the clamp vice is not equipped with a torque device.

d) *Shearing knife*

e) *Tweezers*

f) *A fine camel hair brush*

7.2.4 *Checking Accessories* — such as stop-watch and spirit-level for initial checking of the strength testing instrument.

8. ADJUSTMENT AND CALIBRATION OF THE INSTRUMENT

8.1 Adjustment of the Instrument — Adjust the instrument in accordance with the instructions given in Appendices A and B for specific instrument or with the manufacturer's instructions.

8.2 Calibration — After the adjustment of the instrument, test the standard calibration cotton samples on the instrument. Ensure acceptable

results on the standard samples before performing tests on test specimens. The results may be considered acceptable if they do not depart by more than ±5 percent from the standard values given for the calibration cottons. Repeat the tests on standard calibration cotton samples at regular intervals to ensure a constant level of testing.

8.2.1 When possible, use a standard calibration cotton sample which has an established tenacity similar to that of the cotton being tested.

8.2.2 When the observed value differs from the established value for the standard calibration cotton sample, re-check the apparatus and repeat the test after making necessary adjustments. If the difference still persists, the ratio of the established value to the observed value for the calibration samples shall be used as the multiplying factor for correcting the observed results on test specimens.

NOTE — International Calibration Cotton Standards for tests made at zero gauge length are available from the Cotton Division, Consumers and Marketing Service, US Department of Agriculture, Memphis, Tennessee, USA. These cottons cover approximately the range of the tenacities of all commercial cottons grown in the world. Secondary Calibration Cotton Standards corresponding to the International Calibration Cotton Standards are proposed to be prepared in India.

9. PREPARATION OF TEST SPECIMENS

9.0 Prepare the test specimens by one of the two methods prescribed below. Method A is preferable under tropical conditions.

9.1 Method A

9.1.1 Place the conditioned sliver or mechanically blended sample (**4.3**) across a set of parallel combs (like a comb sorter). Align one end of the sliver after removing the protruding fibres and draw a suitable tuft with the help of a tweezer. Gently comb four or five times to remove the fibres not gripped by the tweezer. Grip the combed end with another tweezer at such a distance from the first tweezer so as to leave fibres having length at least equal to the width of the pair of clamps, along with the spacer, if any. Release the first tweezer and comb the free end of the fibres gently.

9.1.2 Take the tuft of fibres obtained as in **9.1.1** and form it into a flat bundle of 6 mm in width. The flat bundle thus obtained shall constitute a **test specimen**.

9.2 Method B

9.2.1 The test specimen shall consist of pinches taken from the test sample (**4.2**). Hold a tuft obtained by placing pinches one on top of the other near the mid point in one hand between the thumb and the forefinger and comb with a special coarse hand comb. The initial combing

stroke shall not be very deep, and shall be governed by the force necessary to pull the comb through the tuft. Each succeeding stroke shall be slightly deeper, until the teeth of the comb extend all the way through the tuft and the fibres have been combed close to the point held between the fingers.

9.2.2 Discard the fibres removed during combing and pull away and discard the loose fibres from the end of the tuft. Reverse the tuft as held in the fingers and comb the other end of the tuft in a similar manner, making certain that the combs have passed several times between fibres at the centre.

9.2.3 Condition the tuft of fibres to a state of moisture equilibrium in the standard atmosphere (*see* **5.1**).

9.2.4 Hold the prepared tuft between the thumb and fore-finger of the left-hand about one fourth the distance from the end of the tuft. Hold the other end in the same manner and pull out a portion of fibres in the flat bundle.

9.2.5 Hold the loose ends of fibres of the flat bundle with the left-hand in the same manner as before. With the right-hand, comb the bundle of the fibres with a fine comb so that all fibres not held between the fingers of the left-hand will be withdrawn during combing. Hold the fibre bundle again with both hands, with the bundle narrowed to 6 mm in width and pull the other end of the fibres through the comb with the right-hand. The flat bundle thus obtained shall constitute a **test specimen.**

10. TEST PROCEDURE

10.0 Make the necessary preliminary adjustments appropriate to the instruments used.

10.1 Mounting of Fibre Bundle on the Pressley Clamps

10.1.1 *Using Pressley Type Vice* — Take a test specimen and place it in the open fibre clamps at approximately the centre of the lower faces with the ends of the flat bundle projecting approximately to an equal length on each side of the clamp. Hold the bundle against the vice and lower the auxiliary clamp of the vice. Straighten the fibre by applying just enough tension. Then gradually lower the top jaws of the fibre clamps when the fibres are held under tension. Press the top jaws to lock the specimen. Tighten the jaws to a constant torque with the help of the torque wrench, tightening a little at a time, the screws on the two jaws in turn.

NOTE — The torque may be controlled by either a vice-mounted torque indicating attachment or by a friction disc wrench. A torque of about 9 kgf·cm (8 lbf·in) may be used.

10.1.2 *Using Special Vice as in Stelometer* — Grip the test specimen at one end with the sample clip. Comb out all fibres which are not held by the

clip. Holding the clip with its flat side down, grip the other end of the test specimen in the auxiliary clamp of the vice. Draw the clip through the open jaws of the fibre clamps until it clears the jaws and falls to the recessed section of the vice. Raise the hook on the pre-tension lever and position the sample clip so that the hook passes through the hole on the clip. Release the hook to make the clip hang loosely. Close the jaws of the fibre clamps and tighten with the help of the torque wrench the jaw screws gradually till the vice starts to rotate.

NOTE — The torque may be controlled by either a vice-mounted torque indicating attachment or by a friction disc wrench. In order to ascertain that the elasticity of the spring remains the same, the vice shall be checked now and then to see that it starts to rotate with the application of a torque of about 9 kgf·cm (8 lbf·in).

10.2 Remove the clamps from the vice and shear off the protruding ends of the fibres with the shearing knife, shearing downward and away from the movable face of the fibre clamps.

10.3 Adjust the instrument in accordance with the instructions given in Appendices A and B for specific instrument or with the manufacturer's instructions.

10.4 Place the prepared clamps in the instrument, break the specimen and record the breaking load.

10.5 Remove the clamps from the instrument, check to see that all fibres are broken and place the clamps in the vice. If all fibres are not broken, or broken irregularly, or if the breaking load is less than the required minimum for the instrument used, discard the specimen and make a new test. If the break is acceptable, open the clamps, collect all the broken fibres with forceps, or preferably with a fine camel hair brush and weigh them to the nearest 0·01 mg (*see* Note 1 under **11.1.2**). Do not touch the fibres with the fingers while collecting and weighing to avoid gain in weight from moisture pick up.

10.6 Perform the test on a total of at least 10 specimens.

11. CALCULATIONS

11.1 Breaking Tenacity

11.1.1 For test made at *zero gauge length*, based on a bundle length of 11·81 mm (0·465 in), use the following formula:

a) For Pressley type instruments:

$$\text{Breaking tenacity (g per tex)} = \frac{\text{Breaking load in lb} \times 5{\cdot}36}{\text{Bundle weight in mg}}$$

b) For Stelometer type instruments:

$$\text{Breaking tenacity (g per tex)} = \frac{\text{Breaking load in kg} \times 11{\cdot}81}{\text{Bundle weight in mg}}$$

Calculate the mean of all the values and express it as breaking tenacity of the fibres.

11.1.2 For tests made at a *finite gauge length* of 3·175 mm (or 1/8 in) based on a bundle length of 15 mm (0·590 in), use the following formula:

a) For Pressley type instruments:

$$\text{Breaking tenacity (g per tex)} = \frac{\text{Breaking load in lb} \times 6{\cdot}80}{\text{Bundle weight in mg}}$$

b) For Stelometer type instruments:

$$\text{Breaking tenacity (g per tex)} = \frac{\text{Breaking load in kg} \times 15{\cdot}00}{\text{Bundle weight in mg}}$$

Calculate the mean of all values and express it as the breaking tenacity of the fibres.

NOTE 1 — If the variation among the individual test results is not required, combine all tufts and find their weight to the nearest 0·02 mg. Calculate the breaking tenacity by the following formula:

a) For Pressley type instruments:

$$\text{Breaking tenacity (g per tex)} = \frac{\Sigma F}{W} \times K_1$$

b) For Stelometer type instruments:

$$\text{Breaking tenacity (g per tex)} = \frac{\Sigma F}{W} \times K_2$$

where

ΣF = sum of the values of the breaking load of tufts,

W = weight of all the tufts,

K_1 = 5·36 for tests at zero gauge length and 6·80 for tests at finite gauge length, and

K_2 = 11·81 for tests at zero gauge length and 15·00 for tests at finite gauge length.

NOTE 2 — When the Pressley Index is found out, the individual test values shall, not have a significant difference of more than ± 10 percent from the average of all the test values.

12. REPORT

12.0 The test report shall include the following:

a) The average breaking tenacity (g per tex) correct to one decimal place,

b) Type of strength testing instrument used, and

c) Gauge length used.

APPENDIX A

(*Clauses* 1.3, 7.2, 8.1 *and* 10.3)

OPERATION OF THE PRESSLEY FIBRE STRENGTH TESTER*

A-0. DESCRIPTION OF APPARATUS

A-0.1 The Pressley strength tester is an inclined plane fibre strength tester, with a free rolling load carriage, designed to break flat bundles of cotton fibres and to indicate the load required to cause the rupture of the flat bundle. The beam scale is graduated in pound units.

A-1. ADJUSTMENT OF THE INSTRUMENT

A-1.1 Place a thin metal strip in the clamps to prevent movement or separation and insert the clamps in the slots provided in the tester.

A-1.2 Level the instrument with the spirit-level on the carriage track by turning the adjustment screw on the base plate of the instrument. For older models, which are not equipped with the spirit-level, set the carriage track to an angle of 1·5 degrees.

A-1.3 Release the carriage and determine the time required by the carriage to travel from the 5-pound reading to the 20-pound reading. If properly adjusted, it shall take approximately one second.

A-2. OPERATION OF THE INSTRUMENT

A-2.1 Place the clamps, with the flat bundle prepared as in **10.1.1**, **10.1.2** and **10.2**, in the slots provided in the tester.

A-2.2 Release the carriage by gently raising its locking lever. After the carriage stops, record the breaking load from the position of the carriage on the beam scale to the nearest 0·1 pound. If the observed breaking load does not lie between 7 pounds to 15 pounds, discard the specimen and make a new test.

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*Mention of the name of a specific (or proprietory) instrument is not intended to promote, or give preference to, the use of that instrument over others not mentioned.

APPENDIX B

(*Clauses* 1.3, 7.2, 8.1 *and* 10.3)

OPERATION OF THE STELOMETER FIBRE STRENGTH TESTER*

B-0. DESCRIPTION OF APPARATUS

B-0.1 The Stelometer is a pendulum type, constant-rate-of-loading strength testing instrument, designed to break a flat bundle of cotton fibres and to indicate the load required to rupture the specimen. The scale is graduated in kilograms. This instrument is also equipped with a device to indicate the percent fibre elongation for tests made at finite gauge lengths.

B-1. ADJUSTMENT OF THE INSTRUMENT

B-1.1 Level the instrument with the spirit-level by turning the screw immediately below the right handle.

B-1.2 Place a thin metal strip in the fibre clamps to prevent movement or separation and insert the clamps in the slots provided on the tester.

B-1.3 Release the pendulum by depressing the release trigger and determine the time required for the load indicator to advance from 0 to 7 kg. If necessary, adjust the small valve attached to the control cylinder as required to obtain a rate of loading of one kg per second, that is, the load indicator shall travel from 0 to 7 in seven seconds.

B-2. OPERATION OF THE INSTRUMENT

B-2.1 Place the fibre clamps with the fibre bundles, prepared as in **10.1.1, 10.1.2** and **10.2**, in the slots provided in the tester.

B-2.2 Depress the release trigger to start the load indicator moving across the scale. After the bundle breaks and the indicator stops, record the breaking load from the position of the indicator on the scale to the nearest 0·05 kg. If the observed breaking load is less than 3 kg, discard the specimen and make a new test.

*Mention of the name of a specific (or proprietory) instrument is not intended to promote, or give preference to, the use of that instrument over others not mentioned.

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